DEFECTS OF VISION AND HEARING

SMITH

DEFECTS

OF

VISION AND HEARING

IN THE

PUBLIC SCHOOLS

A Hand Book for the Use of Teachers

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TO

MY WIFE

WHO FORMERLY WAS A TEACHER IN THE

PUBLIC SCHOOLS

AND WHOSE KINDLY SUGGESTIONS

HAVE BEEN OF

GREAT VALUE IN THE PREPARATION OF

THESE PAGES

THIS BOOK IS

AFFECTIONATELY DEDICATED

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PREFACE

THE preface of this book is not the author's apology for its publication. There is among educators in the public schools a confessed need of proper instruction respecting the vision and hearing of the children under their care; and since state boards of health and school authorities generally throughout the United States are earnestly considering this matter, and practical tests are now being required of teachers, to ascertain if defects of vision or hearing exist among their pupils, this need is all the more urgent.

Experience teaches and statistics show that many children in the public schools are, in the pursuit of their education, laboring under the disadvantages of defective vision and hearing. Where such defects have been brought to notice, they have in most cases been remedied.

In the preparation of these pages effort has been made to avoid technicalities, and where scientific terms have been used they have in the same connection been explained.

The thought has been to call attention to the more common defects of vision and hearing which are so frequently observed in the public schools; and to set forth the methods by which the teacher can detect them by direct inspection and by suitable tests, at the same time having a comprehensive understanding of the nature of the trouble.

It is hoped that the book may prove helpful to the teacher and at the same time be of benefit to the pupil who may be so unfortunate as to have defective vision or hearing. Fully realizing its many shortcomings, the author offers it for the friendly consideration of the teachers of our public schools.

J. Whitefield Smith.

Bloomington, Illinois,
October 12, 1903.

PART I

Defects of Vision and Hearing in the Public Schools

CHAPTER I

DEFECTS OF VISION DEPENDING UPON THE SHAPE OF THE EYE

FAR-SIGHTEDNESS (HYPERMETROPIA).—One of the most common defects of vision depending upon the shape of the eye is far-sightedness. This condition is caused by the globe of the eye being too short from the front backward. Rays of light passing through the eye are not properly focused on the retina. In far-sightedness, if parallel rays of light were to be brought to a common focus, they would have to be projected to a point *behind* the retina.

Far-sightedness is often noticed in several members of the same family, thus showing its hereditary tendency. As to

the cause of far-sightedness, the defect is usually conceded to be due to arrested development.

Inspection by the Teacher. — The form and appearance of the eye will give valuable information in regard to the defect of vision in far-sightedness. Inspection will reveal the apparent or actual smallness of the eye; as well as the deep position of the eye within the orbit, which is also significant. If we separate the eyelids at their outer angle and direct the far-sighted pupil to look in the opposite direction, thus bringing the external side of the eye prominently into view, it will be observed that the lateral portion is strongly curved, or very convex, and the eye will appear somewhat flattened from the front backward. The orbits are shallow, and the general contour and expression of the face also are characterized by a flat appearance.

These features are most marked in the highest grades of far-sightedness.

The Pupil's Experience.—The far-sighted pupil experiences the most diffi-

culty when he attempts to use his eyes at near work. In the reading of small type, letters on the page become indistinct, and it is with effort that he maintains a distinct image of the print. He is momentarily relieved by looking away from the reading matter for a few seconds and allowing the vision to brighten; but on resumption of work the vision soon becomes indistinct. The pupil frequently must stop reading and rub the eyes gently, or hold them firmly for an instant, in order to get relief. The eyes pain and fill with tears, and the power to focus them on the print becomes exhausted. Not infrequently the pupil must discontinue his work altogether.

The far-sighted pupil often changes the position of the book, trying to bring it into a brighter or stronger light, so that the pupils of the eyes may contract and thereby cut off some of the rays of light, and thus aid the vision. Young far-sighted pupils often hold the book very close to their eyes and squint up the lids until the margins almost touch, in order

to cut off the divergent rays of light. The skin of the eyelids is wrinkled into folds, and the brows are drawn down; the pupil peers at the print, and while he is reading, his expression is anxious and troubled, betraying his imperfect vision.

If the far-sightedness is very pronounced, the eyes look tired and sleepy after protracted reading. Artificial illumination or insufficient light increases the difficulty, and the eyes usually suffer more on dark days or in the evening. The strain on them causes them to ache, and pupils complain of headache which affects chiefly the forehead, but may extend all over the head. Dizziness is frequently a symptom of far-sightedness.

If the conditions continue unfavorable, a train of symptoms supervene which are very noticeable. The lids look swollen and heavy, their margins are reddened, and a sensation of weight and heat is experienced by the sufferer. The conjunctiva,* both of the lids and of the eyeball, is

* *Conjunctiva:* The mucous membrane lining the eyelids and covering the anterior part of the eyeball.

congested, and the lids feel dry and rough. These disturbances may also lead to congestion of the inner structure of the eye.

Method of Determining Far-Sightedness. — An approximate estimate of far-sightedness may be made by the use of the test type, and the one usually employed for the examination is Snellen's.

The card containing the printed letters should be placed on the wall, in a good light, at a distance of twenty feet from the pupil. The series of lines on the card are graduated in size, and are numbered so that the pupil should read correctly, with each eye separately, the line of type corresponding to the number indicating the distance at which it should be legible. If he cannot do this, we suspect an error of vision due to the shape of the eye or disease of the organ.

If the pupil can read only the line of type marked No. 30, we infer that he has about two-thirds vision as compared with a person having normal sight. In making

this estimate, we take for the numerator of the fraction indicating the pupil's acuteness of vision, the distance across the room from the pupil to the test card (twenty feet); for the denominator of the fraction we take the number of the line of type that he can read correctly at the given distance.

It must be remembered that this is only an approximate test of the acuteness of the pupil's vision; but the test, if carefully made, will enable the teacher to determine whether or not any considerable amount of error exists. Pupils with slight degrees of far-sightedness may be able to read the normal line on the test card; in this case they are able to overcome the error by an effort in seeing.

The above test is employed to determine approximately the pupil's acuteness of vision, or, in other words, the power of distant vision. It is also necessary to test the near vision. This is done by ascertaining the nearest point that the finest type (Snellen's, marked 0.50D) can be read correctly with each eye separately; the

small type should be read as close as four and one-half inches from the eye; and read easily at six or seven inches, if the pupil is under twenty-one years of age.

CHAPTER II

THE INFLUENCE OF FAR-SIGHTEDNESS ON SCHOOL WORK

Retards Intellectual Progress.—So far we have endeavored to give the reader some idea of far-sightedness, its causes, and a list of symptoms some of which appear in every case. From the foregoing it is obvious that a child with keen intellectual faculties, if he is so unfortunate as to have a high degree of far-sightedness which is allowed to go uncorrected, should not be expected to do his school work comfortably nor to attain the proficiency in his studies that otherwise might be looked for by his parents and teachers. The child's ability to study is restricted. His opportunities are necessarily limited, and what he does accomplish is with pain and inconvenience.

The child does not realize his condi-

tion, for he cannot discriminate between good vision and vision that is defective. Because of the condition of his sight, he has never known what it means to see easily and well. How important it is, then, for parents to know the condition of their children's eyes! And it certainly is very desirable for teachers to know that their pupils are not laboring under the disadvantage of defective vision.

Every teacher understands that the proper use of the eyes, although to some extent an unconscious process, is an important factor in education. Indeed, the training of the eyes to observe carefully and discriminate accurately is, in itself, an educational process. About ninety per cent of our sense-perception comes to us through sight, and if in a child this function is impaired, his ability to become acquainted with the external world is likewise impaired.

In the education of children the presentative powers or the perceptive faculties are, properly, the first to receive attention, and in their training the vision

is appealed to many times more than any of the other senses; hence the necessity for the child to acquire habits of careful visual perception. Let us illustrate the use of the eyes in an example of an object lesson, and it will be seen how necessary it is for children to have perfect vision; and if any should have an error, how important it is that it should be corrected.

If we take a beautiful and instructive picture and place it before a class of children, some will observe it to a better advantage than others, because they can see it better. The outlines, form and lineaments are more closely observed; the mental image and the impression on the mind are better and more lasting. When the pupils come to study it in detail, the several parts are more clearly discerned by those who have good visual powers. In the study of a picture, children should not be allowed to pass hurriedly from one portion to another, but each feature should be accurately observed and fixed in the mind until all of the salient points have been examined.

If the child has seen the several parts of the picture clearly, it is not difficult for him to recall them separately or collectively as he chooses. But, on the contrary, if the picture has simply been looked at rather than seen, and the successive parts have come dimly into view, and the whole has appeared as through a fog or mist, the child's mental picture will be indistinct and imperfect, and his knowledge of the picture will be correspondingly deficient. Thus the condition of far-sightedness retards intellectual attainment.

Renders Some Parts of the Curriculum Impracticable.—In our deductions on far-sightedness we are considering only the disadvantages due to bad vision. There are many other conditions of the eyes that may interfere in acquiring an education, but for the present our attention is directed to a state of vision due to a physical defect of the organ. As we have already observed, in far-sightedness the formation and shape of the eye are imperfect, and as a consequence its func-

tion, and everything depending on the proper performance of this function, are modified.

Perhaps there is no better way to illustrate these facts than by the use of concrete examples.

Let us take the elementary course in art instruction—a department in the public schools that is of so much importance—and note some of the hindrances that the far-sighted pupil experiences. In nature study take the foliage, the different kinds and forms of leaves, and ask the far-sighted pupil to make an original sketch or copy. He will experience little difficulty in drawing the gross forms, or the different shaped leaves, such as the linear, lance-shaped, oval, ovate, heart-shaped, kidney-shaped, etc., but when it comes to the venation, where he is required to represent the veins, veinlets and nerves with precision, the task becomes an arduous, and in some instances an impossible, one.

The same general conditions are true in many other departments of the school course. In music we find that the far-

sighted pupil has trouble in seeing the form, shape and position of the notes and characters on the staff; these constantly blur and become indistinct. In mathematics it is with great difficulty that he distinguishes the exponents, literal coefficients and algebraic signs; and in higher mathematics his vision is severely taxed in drawing the geometrical figures illustrating the various theorems. Map-drawing is laborious, and in the study of the languages abundant proof is found of his extreme visual burden.

Requires the Best Facilities for School Work.—One of the most important considerations for far-sighted students is the question of light. Nothing is more fatiguing to the eyes than to read or write or draw by an insufficient light. Every far-sighted pupil should if possible be seated so that the rays of light will fall over his left shoulder upon his work, while his eyes are in shadow; the quantity of light should be abundant and the quality of sufficient brightness. Next in importance, perhaps, is the kind of print he

must read: the school books should be printed in good, clear type, not too closely compressed, nor smaller than small pica.

Children should sit comfortably erect, avoiding a bending or stooping posture, so that the return of blood from the head and eyes is not retarded. They should hold the book directly in front of the eyes, at a distance of twelve or fourteen inches.

Far-sighted pupils should not read continuously for long periods of time, as they may completely exhaust their power to focus the print. It is better to work for shorter periods with intervals of relaxation.

While these remarks apply especially to children who are far-sighted and who have not had their defect of vision corrected by suitable glasses, we must not lose sight of the general principle that school children should not be overburdened with near work—that is, work at close range which overtaxes the eyes.

The education of far-sighted children should have in view the choice of a profession or an occupation in which their

vision is not required for very fine or continued work.

PRODUCES REFLEX NERVOUS SYMPTOMS.—From the list of symptoms already considered it is apparent that the general nervous system must at least sympathize with the organ of vision under so tremendous a strain. Brain activity is interrupted by far-sightedness, and no amount of will power can fix the attention of the pupil on his books. But this is not the most detrimental feature; nervous symptoms, reflex in character—such as sick headache, neuralgia, chorea, etc.—may be directly attributed to far-sightedness or to some other visual defect. Not only is the child's school work rendered difficult, but his health may become seriously impaired. In these conditions depending on error of vision, medication is worse than useless. The only relief that can be permanent is in properly correcting the condition by suitable glasses.

CHAPTER III

NEAR-SIGHTEDNESS (MYOPIA)

Is Exactly the Opposite of Far-Sightedness. — By near-sightedness we mean a condition in which the diameter of the globe of the eye from the front backward is so long that parallel rays, instead of being focused on the retina, are brought to a common focus in front of the retina.

Far-sightedness exists from birth, near-sightedness is acquired. Far-sightedness is better adapted for distant vision, near-sightedness for near vision. Far-sightedness is the rule in the uncivilized races; near-sightedness may be regarded as the result of civilization. Far-sightedness is found among the uneducated classes; near-sightedness occurs among the educated, occasioned by the constant demand on near vision. Far-sightedness is suited to outdoor occupations, near-sightedness to indoor work.

Near-sightedness is most frequently caused by the optic axis being too long; that is, the diameter from the front backward is longer than in the normal eye.

INSPECTION BY THE TEACHER.—The condition of near-sightedness may be fairly well determined by direct inspection. In the higher degrees of near-sightedness the eyeballs are large and appear prominent. The palpebral fissure* is wide; and the equatorial surface is not so strongly curved, but on the contrary is elongated and extends backward nearly straight. In high grades of near-sightedness the pupil of the eye is dilated, and the person has to some extent an expressionless countenance because he cannot determine distinctly the features of those at a little distance from him.

Another symptom characteristic of near-sightedness is the manner in which pupils move the head in reading. They hold the book still, but close to the face, and move the head from the beginning to

* *Palpebral fissure:* The opening between the eyelids.

the end of the line they are reading. Frequently in near-sightedness one eye will diverge, or be directed outward.

THE EXPERIENCE OF THE PUPIL.—Near-sighted pupils have a habit of blinking the eyes, to which fact is due the term myopia. The subject squints up the lids to shut out the light, and thus diminish the circles of diffusion on the retina. Distant objects are seen indistinctly, and the near-sighted person's horizon is limited and appears as in a mist or fog. He, however, sees well and with little or no effort objects near at hand. In these particulars the condition is just the opposite of far-sightedness. In that form of error, we saw that the subject could see distant objects more clearly and easily than those near by.

The near-sighted pupil experiences pain in the eyes, and a sense of fatigue and dread of light. The lids are irritable and the eyeballs are sensitive to pressure. The conjunctiva is congested, and the subject frequently complains of seeing black spots floating before the eyes; headache also is a very common symptom.

METHOD OF DETERMINING NEAR-SIGHTEDNESS. — The remedy for near-sightedness is found in properly fitting concave glasses. In estimating the condition and amount of error in near-sightedness, we may proceed as in the directions given for determining far-sightedness.

Snellen's test type for distance should be placed on the wall on a level with the pupil's eyes, in a good illumination, at a distance of twenty feet, and the line noted at which the pupil can read all of the letters plainly and correctly. If he cannot read the line marked No. 20, he has a defect. In testing the near vision we may find that the pupil can read the small letters of Snellen's 0.50D very well at four and one-half or five inches from his eyes, but cannot read the distant type distinctly. In this case suspect near-sightedness.

CHAPTER IV

NEAR-SIGHTEDNESS CAUSED BY SCHOOL WORK

NEAR-SIGHTEDNESS IS ACQUIRED.—This defect practically never occurs in the new-born child; and since it develops later in life, and, in a large majority of instances, in connection with eye-strain in children whose vision has been unduly taxed at near work, it is regarded as a disease.

It is not so prevalent among children who have not been sent to school at an early age. Near-sightedness occasioned by excessive study in school has been rightly named "School Myopia." Near-sightedness is not so common in the grades as in the high school; when children have finished the work in the respective grades and come to the duties of the high school, a correspondingly greater amount of work is required, and the danger of near-sightedness is increased. And,

following this, in the demands of a university education the danger is still greater.

Near-sighted pupils—especially those who have many degrees of error—should be cautioned in regard to the excessive use of their eyes at near work. Internal changes of the eye are liable to be induced, and the vision may become defective to an alarming extent.

Requires Proper Methods of Study. —Of first importance in the case of near-sightedness is an attempt to stop the development and progress. This is mainly accomplished by avoiding the continual straining of the eyes at near work. If near-sightedness is developed in very young children, their games and sports should receive attention and be under competent supervision. Children with high grades of near-sightedness do not care for outdoor sports; they do not see well, and for this reason prefer indoor amusements. They readily become interested in puzzles, dissected maps, authors, card-sewing, etc. But this may prove

burdensome to their eyes, and increase their defective vision.

In their school work they should be given books printed in good clear type of sufficient size. The writing should be of good-sized letters and with uniform, fairly heavy lines. Very fine work in the industrial departments—such as fine sewing, delicate drawings, etc.—should be avoided altogether by near-sighted children.

The book should be held in front of the near-sighted pupil, at an angle of forty-five degrees to the plane of the face. The importance of good illumination cannot be too strongly emphasized. Nothing is more productive of near-sightedness than attempts to do near work by insufficient light. This not only favors the development of the defect, but increases it when it is once established. Children should never be compelled to read or study by a dim light, and in case of near-sightedness they should do as little near work as possible by artificial light.

Modifies the Course of Study.—We have seen that in far-sightedness some departments of the curriculum are influenced by the condition of bad vision, and in the error we are now considering the same thing is true. In our illustration of the study of a picture or painting, far-sighted pupils worked at a disadvantage. In the case of near-sightedness, let us substitute the original landscape of which the picture or painting was a copy, and observe the effect. If the distant view consists of a farm scene with herds of cattle and horses, ripened fields of grain, clumps of trees, babbling brooks and silent ponds, bevies of birds, luxuriant vegetation, beautiful flowers and foliage, etc., the near-sighted pupil can see only the gross forms, and the objects appear hazy and indistinct; all small objects are obscured from view, and if he should be asked to enumerate what he had seen, the landscape could not be recognized by the description.

In the schoolroom near-sighted pupils have great difficulty in reading the work

placed on the blackboard, if they are seated at some distance from it. The same difficulty is experienced if they are required to draw a map or make a drawing from a copy hung on the wall. In order to see a map placed on the wall they must go close up to it.

In most of our schools a great deal of work consisting of reviews, original problems in arithmetic, maps to be copied, spelling lessons, examination questions, etc., are placed on the board by the teacher for the pupils to copy. It is in this sort of work that the near-sighted pupil has the most difficult task.

It is the very popular and commendable custom of some teachers to take their pupils on excursions to the country to study nature and natural scenery; geological and botanical specimens are gathered and classified, and in this way the flora and fauna of the locality are made familiar to the student. Near-sighted pupils cannot engage in this mode of study to the same extent as pupils with normal vision. They are even less

capable of it than those who are far-sighted.

RESTRICTS EMPLOYMENT.—The fact that near-sighted eyes usually have sharp vision for objects near by leads their possessor to think that he has very strong eyes. This is by no means necessarily true. The reason near-sighted people have good vision at close range is that the image of the object on the retina is larger than in the case of the normal eye, or of the far-sighted eye; and again, the near-sighted person's far point* is much nearer to his eye, and he requires but little effort to see distant objects.

For these reasons near-sighted pupils, when allowed a choice, naturally select occupations requiring close application of the eyes on fine work at close range. This frequently proves to be a fatal mistake, for, as we have seen, it tends to increase the amount of error. It is the duty of physicians and teachers to discourage

* Far point (*punctum remotum*): the farthest point of distinct vision, or the farthest point at which an object can be distinctly seen with the eye in repose.

near-sighted pupils from engaging in occupations of this kind.

There is a long list of employments that near-sighted people should avoid: they should never be, for instance, jewelers, watchmakers, engravers, lithographers, typesetters, or proofreaders; and for stenography and shorthand, needlework and embroidery, they are totally unsuited.

Demands Special Care in the Student.—In this age of books we are apt to forget, in our eagerness for intellectual attainment, that children differ as much in regard to the strength of their eyes and ability to use them as they differ in their physical strength and constitution. What, then, is a reasonable task for one child may prove a burden to another. Children with near-sighted eyes should be considered as possessing weak visual organs, and though such eyes may be useful, and with proper care render efficient service, they are subjected to many dangers in the acquirement of an education.

If the near-sightedness is "progressive" in character, the need for care is all the

more imperative. No amount of education can compensate for the loss of vision.

Statistics bearing on this point have caused much anxiety, and endeavors have been made to put a stop to the evil. Careful direction and counsel from competent medical authority only should determine the near-sighted pupil's career in school, and the teacher can be of valuable service in pointing out to parents the extreme necessity of timely action in the care of their children's eyes.

CHAPTER V

ASTIGMATISM

DEFINITION.—By astigmatism we mean a condition of the eye depending upon irregular curvatures of the cornea or an oblique position of the crystalline lens, which, instead of bringing parallel rays of light to a common focus, produce a diffusion image on the retina.

Most frequently the cornea is the seat of astigmatism, and in such cases the state of the vision differs in the meridians of the eye; whereas, in irregular astigmatism, the same meridian presents different degrees of curvature. In regular astigmatism there are always two principal meridians—one of the greatest and one of the least refractive power—and these are always at right angles to each other. The vertical meridian usually has the highest refraction.

It should be remembered that the cornea is not perfectly spherical in the

normal eye; it is a little wider in the transverse diameter (about 1 mm). Therefore, the longest radius of curvature is in the horizontal meridian, and this is usually the meridian of the least refractive power.

We found that in far-sightedness and in near-sightedness the bad vision is due to the *shape of the eyeball*, taken as a whole. In astigmatism we find that the error is due to peculiarities of shape, but in this case it pertains to the *shape of the cornea or lens only*, and more especially to the shape of the cornea. If all the meridians of the cornea were alike in focal length and curvature, there could be no corneal astigmatism; but when they differ in curvature, the meridian of the shortest radius will have the highest refraction, and the meridian of the longest radius the lowest refraction.

From this it is evident that no well-defined image can be focused on the retina; there is always an overlapping of different parts of the object, which produces a blurred or diffusion image.

Inspection by the Teacher. — The symptoms of astigmatism are in many respects similar to those of far-sightedness and of near-sightedness; for in many cases astigmatism is associated with each of these errors. One of the most common symptoms that may be observed is the inability of the subject to see well either near by or far away, if the degree is high. The eyes are weak and sensitive to light; the conjunctiva is reddened; the margins of the lids are irritated, and frequently small tumors are found upon the lids.

In looking with one eye at an object, the pupil usually turns his head slightly to one side instead of looking squarely at it. In very high grades of astigmatism, by direct inspection we may observe the oval appearance of the cornea.

Another symptom of importance is the distorted appearance of the image cast on the cornea by any object reflected upon it—particularly by a circular or a square object.

The Pupil's Experience in Astigmatism.—The symptoms of astigmatism are

characteristic; perhaps the most common symptom, aside from bad vision, is headache. It is estimated that at least sixty per cent of headaches not depending on disease are caused by astigmatism—alone or in connection with other visual errors. Even low grades of astigmatism are very productive of headache, which may be situated in the forehead and temples or may extend all over the head.

Many of the symptoms already enumerated in connection with far-sightedness and near-sightedness belong also to astigmatism, viz., pain, redness of the conjunctiva, squinting of the lids, dread of light, and irritability not only of the eyes but of the nervous system, induced by the frequent attacks of headache.

The manner of seeing objects is a means of determining astigmatism in the pupil, for to the astigmatic eye lines running in certain directions will appear distinct, while the same kind of lines extending at right angles to these will appear to be blurred. In other words, a straight line may look distinct or indis-

tinct to an astigmatic eye, according to the direction it takes. In high degrees of astigmatism all circular surfaces appear elliptical. The full moon, for example, appears to have a long axis; a circle placed on the blackboard will look like a ring drawn out; and some of the figures on the clock dial will appear clear, while others of the same size and brightness are hazy and indistinct.

Let us notice how letters look to an astigmatic eye. We will presume that the meridian at fault is either the vertical or the horizontal. Some letters, like H, are made principally with vertical strokes, while others, like E, contain more horizontal lines. If the astigmatic eye sees E more plainly than H, because the horizontal lines of E appear more distinct, we conclude that the vertical meridian is normal, as the horizontal lines of the letter E are composed of an infinite number of short vertical lines, and the vertical stroke of E is composed of short horizontal lines.

In reading small print the same thing

holds true, in so far as some letters or parts of letters appear more distinct than others. This confusion of the retinal image keeps up a constant demand on the vision for a better focus, and thus the eyes are under a continual strain, which leads to pain in the eyes and severe headache.

The Determination of Astigmatism.—This defect may be fairly well determined by the use of Snellen's Astigmatic Chart. The pupil should be seated twenty feet from the chart and asked to select, with each eye separately, the blackest or most distinct lines. If he selects the horizontal line, the horizontal meridian of the eye is at fault. If the vertical line appears the most distinct, the vertical meridian of the eye is in error. If all the lines of the chart appear equally distinct, astigmatism is not indicated.

CHAPTER VI

THE MOST COMMON OF ALL REFRACTIVE ERRORS

Astigmatism of the Normal Eye.—In 1793 Thomas Young, who was himself astigmatic, discovered this form of error, and brought it to notice. Because of the shape of the normal eye, there is ordinarily a difference of refraction of the two principal meridians, which gives rise to a small amount of astigmatism. If this in no way interferes with the vision, it is called normal astigmatism, or regular astigmatism of the normal eye.

In order to understand why this is true, it must be remembered that the cornea is not a segment of a sphere, but of an ellipsoid, with its widest diameter in the horizontal direction. The average diameter of the vertical meridian is about 11 mm. and of the horizontal meridian about 12 mm. Hence, there would be a little discrepancy in the normal eye. When

greater differences in the curvature of the two principal meridians exist, there are also disturbances of the acuteness of vision, and calls for correction by the use of cylindrical glasses.

Interferes with Literary Pursuits.—In the earlier years of childhood, when the school work is not burdensome or fatiguing to the eyes, and when there is more freedom in the intervals of relaxation from study, children do not complain so much from the effects of astigmatism. But as the work grows harder, and more consecutive hours are required at study, astigmatic eyes become painful and weary. The ambition of the pupil is restrained and his zeal diminished.

If the pupil is attentive and studious in school, it is only because of the kindly solicitation or admonition of the teacher—"Please give attention to your books," or, "Let there be no idle ones in the room."

With this defect of vision, as with the others we have considered, some kinds of school work are more trying than others. Music, as might be expected, will be

somewhat difficult, for it has to do with lines and spaces, notes and characters extending in different directions. Writing and drawing are very fatiguing to astigmatic eyes, and painting becomes not only burdensome but painful.

Affects the Discipline of the School. —The teacher realizes that, in order to attain the best order in school, it is necessary to keep the pupils busy and interested. This is impossible with children suffering from defective vision, and particularly when the refractional error produces a general condition of irritability. If a child is nervous, or affected with pain or discomfort of the head or eyes, he naturally becomes indifferent to his work, and to the discipline necessary to maintain good order. The condition of astigmatism is liable to beget habits of carelessness and absent-mindedness in school children; it is not that these shortcomings are traits of their character, but their painful vision prevents them from being attentive and from concentrating their minds on their work.

The restlessness that is observed in some pupils is no doubt due in many instances to the reflex nervous state induced by astigmatism. Frequently children will manifest a tendency to look out of the window—at no object in particular, but simply as a means of relief from the strain upon their eyes. These symptoms should be carefully distinguished from idleness on the part of the pupil.

The importance of ascertaining the condition of astigmatism, whether it exists by itself or in connection with other errors of vision, cannot be too strongly emphasized; for the comfort and health of the child may depend largely on the state of the eyes. It is understood today that nearly every function of the body may be influenced or modified by visual defects depending on refractional errors.

CHAPTER VII

CROSS-EYES (STRABISMUS)

DEFINITION. — Cross-eyes may be defined as a condition in which one of the eyes deviates from the normal direction, when the subject attempts to look at an object with both eyes. This condition is also called "squint."

INSPECTION BY THE TEACHER.—Squint is usually evident in the appearance of the eyes. The condition is commonly known as cross-eyes, and ordinarily direct inspection will determine whether or not in looking at a distant object both eyes are directed alike to it.

If one eye turns inward toward the nose and the other is directed straight forward toward the object, the former is denominated the "squinting eye," and the latter the "fixing eye."

THE PUPIL'S EXPERIENCE.—The most common symptom, perhaps, is that of

double vision (diplopia). If the muscular equilibrium is disturbed to the extent of producing double vision, the condition becomes very annoying; every object appears as two, and the pupil is in a state of constant confusion for a time, but frequently the double vision ceases, for the pupil soon learns to *suppress* or *exclude* the false image of the squinting eye.

Another symptom is that the vision of the squinting eye is not so good as that of the fixing eye.

If the squint is due to paralysis of the nerves that supply the ocular muscles, there are the following symptoms: Characteristic carriage of the head; vertigo or dizziness, resulting from the difficulty in distinguishing between the true and the false image; a loss or limitation of movement of the squinting eye.

The Determination of the Squinting Eye.—Hold an object, say a lead pencil, vertical before the eyes, about two feet from them, and gradually bring it to the face, observing the eyes all the time. If one of the eyes "fixes" the pencil, and, as

the pencil approaches the face, the other turns in, the eye turning in has convergent strabismus. If, while the pencil approaches the face, one eye turns outward, the case is one of divergent strabismus. If both eyes follow the pencil for a little distance, and then one stops or makes a few jerking movements, that eye has paralytic strabismus.

CHAPTER VIII

DISADVANTAGES OF CROSS-EYES

CROSS-EYES THE RESULT OF FAR-SIGHTEDNESS AND NEAR-SIGHTEDNESS.—It is estimated that seventy-five per cent of all cases of convergent strabismus are associated with far-sightedness. In convergent strabismus the eye is directed inward, and there are several factors that enter into the causation. The power of the eyes to focus is usually taxed in far-sightedness, in order to maintain a distant image, and this probably is one important agent. Again, where squint occurs, one eye is usually defective in vision and may have been so some time before the squinting appeared as a result; hence unequal vision of the two eyes is no doubt an important factor. Since cross-eyes develops at an early age of childhood, when the child begins to use his focusing power to fix near objects, it would seem that "close work" is inti-

mately associated with this muscular error.

Divergent squint is the rule in near-sighted eyes; the eye turns out toward the temple. About sixty per cent of all subjects of divergent squint are near-sighted. The condition is not developed in early childhood, but makes its appearance in youth and early adolescence. The tendency of divergent squint is to become worse as the subject grows older.

Produces Weak Sight from Non-Use.—Weak sight or blunt sight is developed in squinting eyes that have not been exercised or trained in seeing. In children, if the squinting is alternating in character—that is, if first one eye fixes an object and then the other—the strength of vision in each eye may remain about the same, but if the individual always uses the same eye to "fix," the squinting eye usually grows decidedly dim.

It seems to lose its vision from non-use; the sensitiveness of the retina to light and to images is reduced, and its

normal functional activity cannot be restored. This applies to the retina before it has developed its full strength and capacity. From this it is evident that children affected by squint should have early medical advice, and the cause of the trouble be determined and removed, if possible, at once.

The treatment of cross-eyes not due to paralysis but depending on refractional errors, should consist of the putting on of properly fitting glasses. Usually in children the squint will disappear in a few months; if it does not, surgical interference is suggested.

Reduces Visual Power.—With cross-eyes, unless it is of the alternating variety, the child does his school work practically with one eye. Of course this is a disadvantage to a student, for many times the light in the room is such that it cannot be regulated or adjusted to suit the demands of the case. The light may come into the room from the side near the squinting eye, and thus place the work in shadow. Or, in cases of conver-

gent strabismus, if the light should come from the side near the "fixing" eye, it would be diffused directly into the "squinting" eye.

The same difficulties are encountered in divergent strabismus; only the conditions are the reverse. The student is compelled to seek a position that will give him the best light, whether it is comfortable or not.

A squinting eye that has become dim from non-use never becomes totally blind, but retains enough vision to become a very disturbing element in the act of seeing. The visual burden is borne by the "fixing" eye, and if it has an error, the complication is all the more distressing.

EMBARRASSING TO STUDENTS.—Calisthenic drills and physical culture exercises constitute a prominent department in school work. These are begun in the primary grades and continued, to a certain extent, throughout the school course. Children with cross-eyes are placed at some disadvantage in carrying out this part of the program. As their vision depends on one

eye, many of their movements are awkward.

The advantages of binocular vision—that is single vision with the two eyes—are numerous. Children must learn as a matter of education to measure with their eyes the objects of the field of vision in perspective, such as length, breadth and depth, size, space, motion, etc.

These advantages enter largely into the various drills and exercises, which are a physical benefit as well as a mental training. Children whose vision is limited to one eye by squint are unable to make as exact estimates in the performance of these exercises as those who have perfect control of both eyes.

CHAPTER IX

WEAK SIGHT (ASTHENOPIA)

SCOPE OF THE TERM.—Weak sight includes a group of symptoms that may appear in connection with far-sightedness, near-sightedness, or astigmatism; or it may exist quite independent of any of these errors.

INSPECTION BY THE TEACHER.—Regarding the appearance of the eyes in weak sight, the following may be observed: The eyes are red, due to congestion of the conjunctiva; they look weak, which is signified by their "weak sight"; the margins of the lids are congested; there is dread of light, shown by the subject shading the eyes, or directing them down toward the feet. The eyelids are frequently closed tightly so as to compress the eyeballs, or further relief is sought in pressing them tightly in their sockets with the fingers.

The Pupil's Experience.—The symptoms are numerous and varied; pain, and the inability to use the eyes at near work with comfort, are, however, the most prominent. The pain may be situated in the eyes or may radiate through the head, occasionally extending to the back of the neck. Usually it is not severe in character, but is very persistent, being worse in the evening, after the day's work.

The subject frequently complains of dizziness and a dazzling light before the eyes. The eyes are hot as well as painful, and the discomfort is increased when they are further heated by the illumination used in reading by artificial light.

In extreme cases of weak sight, wakefulness, palpitation of the heart, indigestion and nausea have been observed.

The Correction of Weak Sight.—Weak sight associated with refractional errors, such as far-sightedness, near-sightedness, or astigmatism is usually relieved by proper glasses.

In weak sight due to nervous conditions, absolute rest of the eyes should be

enjoined and the nervous system treated by the use of tonics, alteratives, etc. The use of electricity is frequently very beneficial.

CHAPTER X

WEAK SIGHT IN RELATION TO EDUCATION

NOT COMMON IN THE GRADE SCHOOLS.—Weak sight is not common in the grade schools. The children that are strong and healthy, even though they have some error of vision, may be able to overcome it by a vigorous effort, and the symptoms may not develop, or, rather, may be resisted for a few years. If their health becomes impaired, or if their vitality is reduced from any cause, symptoms of weak sight will appear.

Very marked cases of weak sight do appear in children, and the symptoms are aggravated by their work in the primary and intermediate grades; but as a general thing the distressing symptoms of weak sight are not developed until the pupil enters the high school or college. The extra burden thrown upon the eyes by the necessity of a great amount of reading—not only of text-books, but of books

used in supplementary work on collateral subjects—is usually sufficient to produce the symptoms if an error of vision exists, or if the pupil is of a nervous temperament.

Demands Time in Educational Work. —Students affected with weak sight often make the mistake of attempting to do too much work. They should realize that the nervous condition induced by their state of vision disqualifies them to a certain extent for long and protracted periods of study. Their health is involved in a measure with their education, and they should consider the importance of doing justice to both.

To accomplish this the student with weak sight should give due regard to all hygienic requirements, and limit his school work to the time at his disposal. He should not attempt to hurry through the course, by taking an extra number of studies, nor to make up for work that he has not already accomplished, in order to enter grades with "advanced standing." His defect of vision necessarily demands

time in acquiring an education, and his education, his health and the state of his vision will be better in the end if he will take the reasonable time that his condition requires.

Weak Sight in Nervous Students.—Weak sight is most distinctly manifest in the inability to use the eyes at near work for any length of time. A student with weak sight can see fine print for a few minutes only, and then the vision blurs, the print is indistinct and the words seem to mingle; if he discontinues the work and begins again in the course of an hour or so, after five or ten minutes' use of the eyes the same thing occurs. This of itself has a tendency to discourage nervous students and make them irritable.

In connection with this, pain is inaugurated in the eyes, and distressing headaches supervene which quite unfit the student for work. A pre-existing nervous state may be the cause of the weak sight, or a condition of nervous prostration may be the result of weak sight. Children of nervous temperament and delicate consti-

tution suffering from this condition of vision should be warned in time, or the consequences may be serious.

In Educational Departments. — The term education is so broad in its application that it is often necessary to speak of its various departments or special fields of activity.

Individuals possessing weak sight cannot pursue certain lines of study or professional work to advantage. In typewriting, for illustration, the operator must first direct his eyes to the copy and then to the manuscript; this occasions an incessant change of the focus of the eye. Weak eyes soon become fatigued by this work.

Another illustration of the disadvantages of weak sight is found in bookkeeping; weak eyes become very tired in making the transfer from the day book to the ledger.

Indeed, all kinds of study or employment requiring the eyes to hold either an interrupted focus or a continued focus for any considerable length of time, must

result in pain and discomfort to those possessing weak vision.

In the Study of Science.—Mathematics and astronomy are very trying studies to students of weak sight. Mathematics being an exact science, each step in its process must be clearly seen by the eyes as well as with the mind. In the practical study of astronomy the eyes are exercised in accurate, instant observations as well as in mathematical computations. Physics and chemistry call forth a large amount of painstaking labor, both in the study of the text and in the practical experiments. Students possessing weak sight often find their eyes becoming very painful in performing some of the delicate tests and experiments.

Zoölogy and botany present some difficulties. The histological work is very hard on weak sight, and the preparation and preservation of tiny specimens, together with the study of their minute structure, are attended by fatigue and a feeling of discomfort in the eyes.

In Art.—In the useful arts—such as

agriculture, horticulture and some departments of mechanical engineering—the pupil can perform the duties with a reasonable degree of comfort, compared with the demands on the vision in the application of the fine arts.

An enormous strain is put upon the eyes in the execution of the fine arts—as in architecture, sculpture, drawing and decorating, painting, engraving, etc. These require the closest scrutiny with the eyes, and in individuals of weak sight these kinds of employment cannot be performed without much distress.

Students so affected should be apprised of their condition early, if possible, and their education should be directed not only in the interest of their vision, but with some regard to their future work.

CHAPTER XI

COLOR-BLINDNESS

THE COLOR SENSE.—In the preceding chapters we have been considering mainly the subdivision of the sense of sight known as the form-sense, and the method of determining it by means of the test letters.

Another sense of sight that we need only mention is the light-sense, which is the power the retina possesses of distinguishing variations in the intensity of light.

Still another important subdivision of the sense of sight is the color-sense. This is the power which the retina possesses of perceiving color.

Some individuals are unable to distinguish colors, or, in other words, the color-sense is entirely absent, and all objects appear gray, with different degrees of intensity. This is known as total color-

blindness—a condition, however, that is very uncommon.

Partial color-blindness is of more frequent occurrence, and is usually congenital; it is regarded as hereditary. Color-blindness may be acquired as the result of disease or injury.

Professor Dalton—a distinguished English chemist who was affected with color-blindness, being red-blind—was the first to describe defects of the color-sense. He published, in 1774, an account of his own defect, which was of unusual interest to scientists. Because of the discoverer, color-blindness was given the name of Daltonism.

Objective Symptoms.—Dr. J. Ellis Jennings, in his admirable work on color-blindness and color-vision, has enumerated, under the topical head, "Peculiar Look of the Color-Blind," a list of objective symptoms which are very important and suggestive. They are expressed in the author's own words as follows:

A peculiar look of the color-blind was first noticed by Professor Wilson, of Edinburgh,

and described by him as "an absent, anxious glance," as "a startled, restless look," and as "an eager, prying, aimless air." Dr. B. Joy Jeffries has observed this peculiar look in a number of color-blind. He describes it as "a certain liquid look, as if the eyes were slightly suffused. . . . It gives the color-blind person the appearance of not listening or not being interested in what is said to him." Professor Wartmann remarks, "I have observed, in the case of 'Daltonians' whose eyes are brown, a golden lustre of a peculiar tint, when the eye is viewed under an incidence of some obliquity."

Subjective Symptoms.—Color-blindness is usually partial, and Helmholtz has classified it thus: blue-blindness, or violet-blindness, green-blindness and red-blindness. These embrace the three fundamental colors, and where partial color-blindness exists, the subject loses the power to perceive one, but retains the power to distinguish the other two. Ordinarily, there are no subjective symptoms giving rise to much annoyance except in certain business pursuits. The subject learns the names of colors, and

learns to associate them with the object as a psychical rather than a visual act. He knows the old familiar similes, "blue as the sky," "green as grass," and "red as blood"; hence, in speaking of the sky, of the grass or of blood he would assign to each its proper color.

The Detection of Color-Blindness.—There are several practical methods for testing the color-vision. That of Professor Holmgren is convenient, and consists in determining the ability of the patient to match the various colors of skeins of yarn. The test skeins comprise (a) light, pure green, (b) rose-purple, (c) red.

A number of skeins for the subject to select from are colored red, blue, yellow, green, orange, pink, purple, yellow-green, blue-green, violet, brown, and gray. These are of several shades and tints.

The subject is seated at a table in a good illumination (daylight), and the skeins are placed in a bunch on a white cloth on the table; the subject should be informed that no two shades are exactly alike, but that he is required to select

skeins from the bunch that resemble the test-skein in color; that he cannot find exact duplicates of the test-skein, and furthermore that his inability to name all of the various shades and tints of the colors correctly is no proof of his being color-blind.

First Test: With this understanding, the subject may begin by selecting from the bunch, and laying near the green test skein, all the skeins of the same color. If his color-sense is normal, he will promptly select the green-tinted skeins and those only. If he is color-blind, either completely or incompletely, he will select confusion colors, such as grays, pinks, stone, slate, yellows, drabs, fawn, etc.

Second Test: The next test consists in determining the nature and degree of the color-blindness.

The skeins are all mixed again, and this time a rose or rose-purple is used for the test. The subject is asked to continue as before in matching the test skein. If he confuses the colors, selecting either the purple, blue or violet, and these of the

deeper colors, he should be considered as completely red-blind. If he attempts to match the rose skein with green or gray skeins, he is completely green-blind.

Third Test: If the subject be asked to match the red test skein according to the method above, if he is red-blind he will confuse green and dark shades of brown in his selection; if he is green-blind, he will select light shades of green and brown.

Fourth Test: Blue-blindness or violet-blindness is indicated when there is a tendency to confuse purple, red and orange in matching the rose skein.

CHAPTER XII

COLOR-BLINDNESS IN THE PUBLIC SCHOOLS

COLOR-BLINDNESS IN SEX.—It is estimated that four per cent of males and about one-fourth of one per cent of females are color-blind. The proportion is one to twenty-five among males, and one to four hundred among females. The reason of color-blindnes being so rare among females is problematical; it is generally supposed that the nature of their work in handling color develops their color-sense to a higher degree of perfection, and according to the laws of inheritance produces a sexual distinction.

The red-blind are called protanopes, and the green-blind deuteranopes. Red-blindness is the most common form of color-blindness.

Colored vision—the result of disease or of some irritation of the visual centers—may affect either sex alike.

Red vision (erythropsia) sometimes occurs after an operation for cataract: all objects appear red—usually like a rosy dawn or a crimson sunset. Blue vision (kyanopsia) is occasionally met with in nervous children. Work Dodd has collected thirteen published cases of green vision, in which everything appears green to the individual.

Thus we may be blind to the sensation of any one of the three fundamental colors—that is, blind to red, or green or blue (violet); or the vision may be saturated with any one of the fundamental colors, in which case everything looks red or green or blue.

Color-Blindness and the Kindergarten.—In considering the effect of color-blindness in the schools, we might, perhaps, better begin with the most rudimentary department, viz., the kindergarten.

Kindergarten schools, unless they are very liberal in their requirements, may prove to be decidedly injurious to the vision of young children. The children

enrolled in the day-nurseries and the kindergartens are usually from four to six years old, and the eyes at this age are delicate in structure; the ocular tissues are not well developed, and are not suited to visual labor at close range. However, the kindergarten has a field of usefulness, and under proper direction can start the little minds on their educational career to advantage.

The instruction requiring the use of the eyes should be from large charts, maps, pictures and diagrams hung in good illumination on the wall. Near work should be persisted in only for a few minutes at a time. Since colored objects are so much used in this grade of work, both to amuse and instruct the children, it is obvious that if any are color-blind they cannot work without becoming confused and making the most awkward mistakes. They cannot learn to harmonize the colors in mat-weaving, daisy chains, card-sewing, etc. If the teacher will test her pupils' color-sense, she may find out why some make slow progress.

Color-Blindness in the High School, and College.—Color-blindness interferes with some branches of study prescribed in the school course. For example, in physics the chapter on optics, and particularly that part treating of the decomposition of light, cannot be demonstrated to the color-blind. Those who are red-blind see only two colors of the rainbow viz., yellow and blue; hence the rainbow to the color-blind is theoretical and hypothetical rather than real.

The study of chemistry furnishes another example of the disadvantages experienced by the color-blind. In metallic chemistry many of the tests depend upon the color of the precipitates thrown down by the reaction of the solution with the reagents. Color-blind students of course have trouble in distinguishing the colors.

In college work the use of the microscope presents some difficulties. In the preparation of the specimens the staining process is apt to be confusing, and in the laboratory work much depends on the proper application of the colors.

Dangerous in Some Employments.—All employments in which color signals are used—such as the colored lights or flags used in railroad and marine service—are dangerous for the color-blind. Not only are their own lives in jeopardy, when they are thus employed, but the lives of those employed with them, and of the traveling public as well.

Postoffice officials, government clerks, railroad employees, merchant marine and the United States army and naval service are now required to take an examination in color-vision. An education looking forward to employment in any of these public services should be preceded by a careful chromatic test, for many times young men in school who have an ambition for this kind of work, later may be disappointed to find out that they have defective color-sense.

In the author's experience recently, in the examination of 247 adult males for railroad service, 15 were color-blind. Some of these were already in the railroad employ, and had been for years, but

when their defect was discovered they were no longer regarded as satisfactory for the service.

INCURABLE.—Color-blindness cannot be cured. It is no doubt due to paralysis, or to the absence in the retina of the perceptive organs for color.

No amount of study or work with colors will improve the color-sense where it is defective or absent. The normal color-sense may be improved by judicious education, and the most delicate tints and shades of color discriminated, but in the color-blind no improvement is to be expected. Disturbances of the color-sense due to disease or accident may disappear, but congenital color-blindness is permanent.

Color-blindness does not necessarily interfere with the vision, and eyes defective in color-sense may be normal in every other respect.

PART II

CHAPTER I

DEAFNESS

THE SENSE OF HEARING.—We have seen in the preceding chapters how important is the *manner* in which luminous vibrations, or the rays of light, are brought to a focus on the retina. In our consideration of hearing we shall see the like importance of having the aerial vibrations or sound waves brought to the labyrinth.

We saw that if the cornea is not symmetrical, and interferes with the proper focusing on the retina of the rays of light, the vision is impaired. Likewise, if the *membrana tympani*, or the middle ear, is defective and interferes with the impingement of the sound waves upon the labyrinth, the hearing is disturbed.

Functionally, the ear may be regarded as consisting of two portions; the *conducting apparatus* and the *perceptive apparatus*. The former consists of the external ear, comprising the auricle and

meatus, and the middle ear or tympanum, including the eustachian tube and mastoid process. The latter consists of the internal ear or labyrinth, containing the auditory nerve endings. In order for the function of hearing to be performed normally, the sound waves must be transmitted without interference or obstruction to the labyrinth by the conducting apparatus.

The perceiving apparatus must receive the sound waves and transmit them as auditory impulses by the auditory nerve to the sensorium, for elaboration and interpretation. The manner in which the sound waves reach the labyrinth is still a mooted question. Dr. A. H. Andrews has briefly epitomized the various opinions held in respect to this, as follows:

Some believe that the sound waves are transmitted from the drum membrane to the labyrinth via the ossicular chain and the oval window; and that the round window acts as a safety valve or pressure regulator for the labyrinthine fluid. Others believe that the sound waves reach the labyrinth through the

round window, and that the function of the oval window and the ossicles with their muscles is to regulate the tension of the drum membrane and the labyrinthine fluid. Still others believe that sound waves reach the labyrinth through both of these routes; while a fourth class believes that in addition to these routes the outer bony wall of the labyrinth is equally responsible for the transmission of the sound waves.

Whatever view we may take, it is plain to be seen that any interference with the normal functional activity of either the conducting or perceiving apparatus will result in impaired hearing or deafness. Deafness may be defined as a diminution or loss of hearing power, and according to the degree, it is either partial or complete. If the hearing is affected by peculiar sounds and noises in the ear (*tinnitus aurum*) this is usually described as a disturbance of the auditory power.

Objective Symptoms of Deafness.—The objective symptoms of partial deafness are usually evident in the manner and actions of the subject; and yet teachers

should distinguish between deafness and habits of carelessness and indifference or of absent-mindedness in their pupils. Listlessness, reverie, inattention, etc., may simulate the characteristics of partial deafness, and a pupil with good hearing power be suspected of a slight defect.

In partial deafness the defect is betrayed by the pupil failing to catch all of the words of an ordinary conversational tone; he may turn his head slightly to one side, bringing his ear closer, or into a better position for gathering the words of the speaker. His facial expression, too, is an index of his difficulty in hearing *all* that is being said to him. If he has been addressed, and is backward or slow in responding, the cause can be depicted in the tiny blush on the cheek and the nervous twinkle of the eyes.

In complete deafness, of course, there is no response to sounds. In disturbances of the hearing caused by noises in the ear, even though the hearing is very good, sometimes pupils appear deaf. This is because their attention is directed

to these subjective symptoms and annoyances.

Subjective Symptoms.—The subjective symptoms depend largely on the cause. Deafness may exist without pain or head noises, and again it may be accompanied by an aggregation of symptoms more distressing than the simple loss of hearing.

Since we are now considering deafness caused by disturbed function—chiefly of the conducting apparatus—we may enumerate some of these cases as follows:

Deafness due to an impaction of the cerumen, or ear wax, in the external auditory meatus. This usually gives rise to symptoms of irritation and uneasiness in the ear. The ear drum may be sensitive and tender in some forms of deafness.

Acute non-suppurative catarrh of the middle ear (*otitus media* without suppuration). This form is attended by deep-seated pain, a feeling of fullness, throbbing, etc., in connection with deafness.

Acute suppurative catarrh of the middle ear (*otitus media* with suppuration). This is characterized by pain, swelling, deafness,

etc., and, in addition, a purulent discharge from the ear. Chronic catarrhal conditions of the middle ear, either with or without suppuration, lead to varying degrees of deafness. If the ossicles or small bones of the ear are involved by the inflammatory process, the discharge is fetid.

Inflammation of the eustachian tube. This offers an obstruction to the free egress and ingress of air to the middle ear and produces disturbance of the hearing.

Many other symptoms exist in connection with deafness, originating in the conducting apparatus, but these may serve to illustrate some of the feelings and sensations experienced by the partially deaf.

Determination of the Hearing Powers.—A simple and convenient test may be made with an ordinary watch, provided we know its hearing distance. Let the subject be seated comfortably and with the eyes closed. Take a watch, say with a hearing distance of twenty inches, and holding it at some distance from the subject, gradually approach the ear under

examination. As soon as the subject gives evidence of hearing the watch tick, we carefully note the distance, and by comparison we may arrive at a fair quantitative test of the hearing power.

The distance in inches at which the subject hears the watch should be taken as the numerator, and the hearing distance of the watch as the denominator of the fraction indicating this power.

Qualitative tests of the hearing are made by the use of tuning forks. Also, the location of the seat of trouble, or the part of the ear affected and causing the deafness, may be determined by the tuning fork.

The human voice serves a very good purpose in testing cases of deafness. Instead of having the subject repeat words and sentences pronounced by the examiner, it is better to have him repeat numbers spoken promiscuously.

CHAPTER II

DEAFNESS IN THE STUDENT

Deafness in Infancy.—Our purpose is to consider the effect of deafness in the pupil more especially from the time he enters school until he finishes the high school or the college. However, it may not be undesirable to notice the evolution or changes of the hearing powers from a state of deafness in the first days of infancy to the almost incredible acuteness of hearing in which the ear is sensible to sounds produced by vibrations of more than forty thousand per second.

Preyer tells us that "all children immediately after birth are deaf." This physiological deafness soon gives away to the perception of sound, unless the child has a congenital defect of the auditory apparatus.

The sense of hearing, like the other special senses, is susceptible of education. At first only sensations of sound are per-

ceived; but later the mental effects are produced. As the child grows older it learns to distinguish sounds and refer them to their cause, etc. The direction of sounds and the distance of their sources are matters of judgment and experience. Binaural audition — that is, hearing by means of the two ears—is an advantage in estimating the distance of the sonorous body.

Effect of Deafness on the Scholar.— A child that is partially deaf must necessarily accomplish his work with difficulty. He cannot hear well the recitations, nor the directions and instructions from his teacher. Much repetition of questions or answers by the teacher is subversive of good discipline, and if a deaf child does not understand what is said, especially when the teacher is addressing remarks in a general way to the pupils, he frequently lets it pass by altogether.

In some grades of the public school some teachers find a very popular way of imparting information to be the relation of a story from real life, or the explanation

of some important mechanism, as the dynamo, or the description of the methods in the manufacture of some familiar article, such as paper, knives, pens, pencils, etc. A child affected with deafness cannot receive the same benefit from this instruction as one with normal hearing. He is liable to lose words, or sentences or parts of sentences, and thus become confused and lose interest. The recitation is of general benefit to the class, as many points of interest are developed that may not be stated in the text, but this also has its disadvantages to the deaf; the misunderstanding of a word may change the entire thought, and lead to erroneous conclusions.

Its Effect on the School. — The principle of attention is no less important in the function of hearing than in the vision of pupils.

A pupil with defective hearing often unintentionally diverts the attention of the entire school. If he is to understand *all* that is said, he necessarily must ask to have some things repeated; if he appeals to the teacher, this causes a break in the

continuity of thought between the teacher and pupils, and if he asks a fellow student for help he may cause his benefactor to lose some essential feature of the work. This is not cited as a criticism on the deaf pupil, but simply to show how deafness can interfere with the harmony and working of the school.

There is also a condition of partial deafness due to disease of the middle ear, which is called Chronic Suppurative Catarrh, that we may mention in this connection—not because of the symptoms of deafness particularly, but because of its disagreeable features.

More than two-thirds of all diseases of the ear are due to catarrhal inflammation, and ninety-five per cent of all diseases of the ear characterized by a discharge are due to the above-named disease. If the chain of ossicles (bones) are affected, the ear becomes offensive. Unless the utmost precautions are observed in the matter of cleanliness, this becomes very obnoxious in the schoolroom. Such cases should seek medical advice and treatment.

Deafness Affects the Student's Work.—Not only is the progress of the school work interfered with, but the character of the work is modified. The reading is frequently in monotones, the inflection and emphasis are faulty, the modulation is imperfect, and the general expression of the voice is characterized by harshness and nasal tones.

This may result from the fact that the student cannot distinguish accurately the pitch and intensity of sounds.

The cultivation of the voice constitutes no small part of the work devolving on the school. If possible, pupils should be taught to produce pure vocal tones of natural smoothness and clearness.

The effect of deafness on the voice is also shown in the study of music. Music is one of the best methods of cultivating the hearing powers; the pupil should reproduce the tones of the piano in the various keys. Ordinarily it is the low-pitched sounds that are the most difficult to hear and reproduce. For example, a pupil who can hear ordinary conversation

very well at a distance of four or five feet, may not be able to hear the low tones of the instrument so well, nor the sound of a bass drum at some distance, nor the roaring of the wind. If the internal ear is affected, causing the deafness, the high-pitched notes are heard less distinctly, or not at all.

Deafness in Special Education.—Certain departments of education and some special fields of labor are denied the deaf.

Among the former which offer an obstacle to the deaf may be mentioned some departments of business education—telegraphy, typewriting, shorthand, etc. These require acute hearing power. Of the latter we may enumerate railroad work, the telephone service, certain departments of government service, the army, the navy, etc.

Nearly all of these require normal hearing as a qualification for service.

Chief among the professions with which bad hearing interferes are medicine, law, music, school-teaching, etc.

Those affected with deafness should

realize that certain occupations will be denied them, and while their education should be broad and general in its application, judgment and care should be exercised in selecting a course of study looking forward to their life work.

CHAPTER III

DEAF-MUTISM

Its Cause.—The loss of hearing power in infancy, or the absence of this special sense occurring as a congenital defect or as the result of disease, is followed by mutism.

Deaf-mutism does not affect the vocal organs except indirectly. The reason that the child does not learn to talk is because it cannot *hear* the human voice to imitate it. Deaf-mutism may occur if the child loses its hearing power soon after it has learned to talk, and according to some authorities it has occurred in children at the ages of seven or nine, upon their losing their hearing at this time in life.

Ordinarily, if the hearing is destroyed or absent before the fifth year the child will not learn to speak. Among the causes which are thought to produce

deaf-mutism are heredity, consanguineous marriages, inherited diseases, and injuries and diseases incidental to childhood, such as scarlatina and diphtheria.

If a child cannot hear sounds of varying pitch and intenstiy at the fourth week—that is, if it does not give some evidence of perceiving loud sound, by movement or otherwise—the probabilities are that it will never hear, and consequently, that it will be without speech.

Objective Symptoms. — The objective symptoms of deaf-mutism are evident when the conditions are sufficiently developed and recognized. As a general thing parents do not recognize the defect early; rarely before the child should begin to talk, or about the end of the first year, and then frequently it is attributed to slow development. Occasionally, where deaf-mutism occurs as a congenital defect, parents insist that the child has been able to hear and that the deafness has occurred recently.

Some of the prominent symptoms that may be observed are a blank look in the

presence of noise, and a changeless expression of the countenance when attempts are made to attract the child's attention by loud sounds, such as shrill whistles or musical instruments, etc.

The child's countenance may respond to the smiles of the parent and to various gesticulations, and these are usually given while the anxious parent is talking to the unfortunate child, and must be carefully attributed to impressions made on its vision rather than on its hearing.

Subjective Symptoms.—The subjective symptoms are not so easily determined. No doubt the deaf mute realizes by some subjective sensation the condition of his defective auditory apparatus. If he is near a large bell that is being rung, or a drum that is being sounded, he can *feel* the vibrations distinctly, and perhaps loud sounds produce some effect on the nervous system through the medium of the ears, even though the sensations cannot be translated as sounds.

Other subjective sensations, such as the consciousness of the presence and posi-

tion of an external object, and also of its absence, are shown in the pressure of the atmosphere on the tympanum.

Professor James illustrates this in the following interesting manner:

The tympanic membrane is, furthermore, able to render sensible difference in the presence of external atmosphere, too slight to be felt either as noise or in this more violent way. If the reader will sit with closed eyes and let a friend approximate some solid object, like a large book, noiselessly to his face, he will immediately become aware of the object's presence and position—likewise of its departure. A friend of the writer, making the experiment for the first time, discriminated unhesitatingly between the three degrees of solidity of a board, a lattice frame, and a sieve, held close to his ear.

Now as this sensation is never used by ordinary persons as a means of perception, we may fairly assume that its felt quality, in those whose attention is called to it for the first time, belongs to it *qua* sensation, and owes nothing to educational suggestions. But this felt quality is most distinctly and unmistakably one of vague spatial vastness in three dimensions—quite as much so as is the felt quality of

the retinal sensation when we lie on our back and fill the entire field of vision with the empty blue sky. When an object is brought near the ear we immediately feel shut in, contracted: when the object is removed, we suddenly feel as if a transparency, clearness, openness, had been made outside of us. And the feeling will, by any one who will take the pains to observe it, be acknowledged to involve the third dimension in a vague unmeasured state.

That the sensation in question is one of tactile rather than of acoustic sensibility would seem proved by the fact that a medical friend of the writer, both of whose *membranæ tympani* are quite normal, but one of whose ears is almost totally deaf, feels the presence and withdrawal of objects as well at one ear as at the other.

Examination of Deaf Mutes. — The examiner should make careful tests in all cases of suspected deaf-mutism, to ascertain if the deafness is complete or partial. In all cases of complete deafness we attribute it to a lesion in some part of the auditory nerve, and speak of it as nerve deafness.

Middle ear disease, however, has pro-

duced such marked deafness in very young children that they have become deaf mutes; but in these cases the hearing power is not entirely absent.

The method employed in determining complete deafness is by the use of loud sounds. In the examination great care should be exercised not to jar the child by the violent vibrations from the sounding instrument employed. Usually the examiner stands behind the child and rings a bell or sounds a shrill whistle (Galton's or Delstanche's).

If the high notes of a Galton whistle do not attract the child's attention, it is very good evidence that the seat of the trouble is in the auditory nerve or some portion of it and the deafness is complete.

Treatment in cases of absolute deafness is useless; if a very slight amount of hearing power can be detected, treatment may be of benefit.

CHAPTER IV

EDUCATION OF DEAF MUTES

THE ORAL SYSTEM.—The German, or pure oral system, became the national system in 1778. The idea is to teach the deaf to understand speech and to enable them to talk. The instruction is imparted by the teacher, by movements of the lips, tongue, jaws, and muscles of the throat, etc. This method, with some modifications, has been used in the United States for more than a third of a century. Oral methods of instruction are now generally preferred to all others; pupils educated by the oral method either acquire or regain speech within certain limits. They also become more or less proficient in reading the lips of others.

Lip-reading or speech-reading does not necessarily imply that the pupil can talk understandingly; often his reading is far in advance of his articulation. The lip-

reader comprehends sentences more easily than words, and words more readily than simple sounds. The speech acquired by those born deaf can be readily understood by their teachers and friends, as is attested in the education of thousands of deaf mutes.

The Sign System. — This is usually spoken of as the French System. The method has for its object the development of the mental and moral powers without the aid of articulate speech. Experience has shown that the best facilities for the acquirement of an education among all classes are in human speech, and for this reason the sign method or silent method has lost favor among educators in deaf-mute schools.

Under some circumstances the sign method is to be preferred to the oral method. In children of mental obliquity or mental deficiency, the sign system has the advantage of being more easily learned and more readily applied.

Pupils educated by the silent method go through life without speech; before

they can comprehend a thing, the thought must be translated into signs.

The Semi-Deaf.—There is a class of children denominated as "hard of hearing"; they are not totally deaf, and yet perhaps are too deaf to attend the public schools to advantage. It is necessary, under these circumstances, to encourage their hearing power, and thus save to them the power of speech, if possible.

Such children can find better advantages in a private or state school for the deaf.

The use of the graphophone has proved of valuable assistance to this class of children, under the guidance and direction of competent teachers. Oral instruction may not improve the hearing, but it quickens their perceptive powers, and possibly will enable them to continue to communicate with others in their own language.